NOTES: See topic "Diabetic Foot Ulcer - Treatment"

(a) Indications for hospital admission:
> DFU involving deeper structures: surgical debridement for DFUs involving ligaments, tendons, muscles or deeper structures
> Infected DFU: IV empiric antibiotic therapy for severe infection and for selected patients with moderate infection. See "Algorithm for selection of empiric antibiotic therapy for diabetic foot infection"
> Ischemic DFU: Urgent vascular imaging and consideration for revascularization if toe pressure < 30 mmHg or TcPO2 < 25 mmHg, if non-healing DFU with either an ankle pressure < 50 mmHg or ABI < 0.5. To see which patients benefit from revascularization, go to "Diabetic Foot Ulcer Associated with Infection - Management"
> Ischemic and Infected DFU: Aggressive control of infection and revascularization immediately after infection is controlled are indicated for moderate or severe infection and PAD. If no immediate response to interventions to treat infection, consider revascularization. If limb/life-threatening infection, amputation may be necessary

(b) Treat the cause:
see Table 1
(c) Address patient’s concerns:
- Pain, depression, anxiety, lifestyle modifications
- Consider patient’s preference when creating plan of care
(d) Educate patient:
- Offloading, glycemic control, local wound care
- Protect extremities from heat, cold, trauma
- Recognize infection (e.g. pain, increased exudate)
(e) Local wound care:
see Table 2, See Wound Prep & Dress Tool
(f) Order consults/ referrals as needed:
- Registered dietician, primary care provider, orthotist for off-loading, podiatrist for foot deformities, vascular specialist, infectious disease specialist, hyperbaric specialist (Wagner 3 and above), behavioral medicine for depression, smoking cessation program
(g) Follow up visits (weekly at a minimum): Telehealth conferencing tool to screen need for face-to-face encounter in between office visits
- Document wound healing progress (e.g. ulcer size, etc)
- Modify dressing if reduced exudate
- Repeat non-invasive vascular assessment if ulcer worsens or not closed in 3 months
- Notify primary care provider if new or increased pain, infection, wound probes to bone, new signs of peripheral arterial disease

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Table 1. Treat the Cause - Diabetic Foot Ulcers

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Control diabetes</strong></td>
<td>For all DFUs: Target HbA1c&lt;7% with strategies to minimize hypoglycemia. Manage hypertension, smoking and hyperlipidemia</td>
</tr>
<tr>
<td><strong>Correct deficiencies</strong></td>
<td>For all DFUs: Correct nutritional deficiencies. Oral supplementation with arginine, glutamine, and β-hydroxy-β-methylbutyrate may be added</td>
</tr>
<tr>
<td><strong>Eliminate pressure/friction/shear forces</strong></td>
<td>For all DFUs: &gt; Protect from physical trauma: Examine footwear (fit, foreign body) &gt; Surgical correction of foot deformities that cannot be accommodated &gt; Offloading devices: Total contact casts (TCCs) and irremovable cast walkers have the highest offloading capacity, followed by removable walkers</td>
</tr>
<tr>
<td><strong>For non-healable or maintenance DFU:</strong> adopt interventions to the extent acceptable by patient and family</td>
<td>For severely infected or ischemic DFU: infection or ischemia should be controlled first before offloading is employed &gt; Do not use TCCs and irremovable cast walkers as these impair frequent ulcer inspections. &gt; If mild PAD or mild infection under control with antibiotics, non-removable knee-high devices may still be an option. For other patients with infected or ischemic DFU, removable cast walkers may be used and are preferred over half shoes.</td>
</tr>
<tr>
<td><strong>Armstrong, David G; Cohen, Kelman; et al. Diabetic foot ulcers and vascular insufficiency: our population has changed, but our methods have not. Journal of diabetes science and technology. 2011;5(6):1591-1595.</strong></td>
<td>For all DFUs: &gt; Osteomyelitis can be treated either primarily medically with antibiotics, or surgically. &gt; Obtain wound culture with validated method after debridement (&quot;and surgical interventions. &gt; Interventions include debridement, topical antimicrobial agents, systemic antibiotics and surgical interventions. &gt; Obtain wound culture with validated method after debridement (&quot;Diagnosis: Wound Cultures&quot;) so that definitive antibiotic therapy can be implemented. &gt; Surgical procedures are indicated for deep abscess, compartment syndrome and virtually all necrotizing soft tissue infections. &gt; Osteomyelitis can be treated either primarily medically with antibiotics, or surgically.</td>
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<tr>
<td><strong>Wounds International. Best Practice Guidelines: Wound Management in Diabetic Foot Ulcers. 2013.</strong></td>
<td>For infected DFUs: &gt; Interventions include debridement, topical antimicrobial agents, systemic antibiotics and surgical interventions. &gt; Obtain wound culture with validated method after debridement (&quot;Diagnosis: Wound Cultures&quot;) so that definitive antibiotic therapy can be implemented. &gt; Surgical procedures are indicated for deep abscess, compartment syndrome and virtually all necrotizing soft tissue infections. &gt; Osteomyelitis can be treated either primarily medically with antibiotics, or surgically.</td>
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<td><strong>For non-infected DFUs:</strong> Use of systemic antibiotics and/or topical antimicrobial dressings not recommended. Antimicrobial dressing may be used on ulcers that do not show signs of improvement</td>
<td></td>
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<tr>
<td><strong>For ischemic DFUs:</strong> &gt;Urgent imaging and revascularization if: ABI &lt;0.5*, Continuous doppler wave ultrasonic with monophasic flow, Toe pressure &lt; 30 mmHg, TcPO2 &lt; 25 mmHg *Regardless of ABI values, to rule out PAD in patients with diabetes: TcPO2, continuous wave Doppler examination or TP/TBI. &gt; Estimate benefit from revascularization using the WIfI classification. See topic &quot;Diabetic Foot Ulcer Associated with Ischemia - Revascularization&quot;</td>
<td></td>
</tr>
<tr>
<td><strong>For infected and ischemic DFUs:</strong> high risk for major limb amputation. &gt; If infection is severe: immediate drainage, debridement, culture, antibiotics and consideration for revascularization &gt; If infection is non-limb-threatening: optimize blood supply to the foot before surgical debridement to ensure salvage of viable tissue</td>
<td></td>
</tr>
<tr>
<td><strong>Lipsky, Benjamin A; Aragón-Sánchez et al. IWGDF guidance on the diagnosis and management of foot infections in persons with diabetes. Diabetes/Metabolism Research and Reviews. 2016;32 Suppl 1():45-74.</strong></td>
<td>For infected DFUs: &gt; Interventions include debridement, topical antimicrobial agents, systemic antibiotics and surgical interventions. &gt; Obtain wound culture with validated method after debridement (&quot;Diagnosis: Wound Cultures&quot;) so that definitive antibiotic therapy can be implemented. &gt; Surgical procedures are indicated for deep abscess, compartment syndrome and virtually all necrotizing soft tissue infections. &gt; Osteomyelitis can be treated either primarily medically with antibiotics, or surgically.</td>
</tr>
<tr>
<td><strong>Diagnosis:</strong> Wound management in diabetic foot ulcers.</td>
<td>Regardless of ABI values, to rule out PAD in patients with diabetes: TcPO2, continuous wave Doppler examination or TP/TBI.</td>
</tr>
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<td><strong>For healed DFU:</strong></td>
<td>If infection is non-limb-threatening: optimize blood supply to the foot before surgical debridement to ensure salvage of viable tissue</td>
</tr>
<tr>
<td><strong>Address PAD Aggressive cardiovascular risk management</strong></td>
<td>If dry or wet gangrene: moisture retentive dressing may cause limb threatening infection</td>
</tr>
<tr>
<td><strong>High risk:</strong> If infection is severe: immediate drainage, debridement, culture, antibiotics and consideration for revascularization</td>
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<tr>
<td><strong>Low risk:</strong> If infection is non-limb-threatening: optimize blood supply to the foot before surgical debridement to ensure salvage of viable tissue</td>
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</tbody>
</table>

Table 2. Local Wound Care

<table>
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<tr>
<th>Intervention</th>
<th>Healable</th>
<th>Non-healable or Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Healable</strong></td>
<td>Debridement</td>
<td><strong>Non-healable or Maintenance</strong></td>
</tr>
<tr>
<td><strong>Cleansing</strong></td>
<td>Gently cleanse with normal saline, sterile water or commercial wound cleanser. Irrigate wound with &gt;100 ml of room/body temperature solution at low pressure (4-15 psi).</td>
<td><strong>Topical anesthetics such as lidocaine-prilocaine cream if needed to reduce debridement pain.</strong></td>
</tr>
<tr>
<td><strong>Debridement</strong></td>
<td>&gt; Initial sharp debridement of all devitalized tissue and callus. Subsequent debridement may be mechanical, autolytic, enzymatic, surgical or combination of methods &gt; Urgent surgical intervention for foot infections involving abscess, gas, or necrotizing fasciitis</td>
<td>&gt; Conservative debridement of non-viable tissue only.</td>
</tr>
<tr>
<td><strong>Infection management</strong></td>
<td>&gt; Use antimicrobial dressings only in cases of clinical infection (e.g. if increasing pain is observed) or if no healing is seen in 4 weeks &gt; Antimicrobial dressings (with cadexomer iodine, silver, etc): &gt; Light exudate: hydrogel or hydrogel colloidal sheet-based &gt; Moderate, heavy exudate: alginate, hydrofiber, super absorbent</td>
<td>&gt; If minimal or light exudate, consider antiseptic solution (e.g. povidone iodine, chlorhexidine)</td>
</tr>
<tr>
<td><strong>Dressings</strong></td>
<td>&gt; If signs of clinical infection, prescribe antibiotics guided by culture if life-threatening infection (e.g. gas gangrene or necrotizing fasciitis) may need amputation. Severely ischemic limbs will require revascularization</td>
<td>If signs of clinical infection, consider non-adherent antimicrobial dressings (with cadexomer iodine, silver, etc).</td>
</tr>
<tr>
<td><strong>Periwound skin care</strong></td>
<td>If excessive exudate: use zinc-based barrier to protect periwound. If xerosis (dry skin) use emollient on the feet for skin hydration</td>
<td>If signs of clinical infection, consider non-adherent antimicrobial dressings (with cadexomer iodine, silver, etc).</td>
</tr>
<tr>
<td><strong>Dressings</strong></td>
<td>&gt; Fill deep wounds to avoid dead space. &gt; Maintain wound moisture with: &gt; Hydrocolloid, hydrogel, moisture retentive foam</td>
<td>&gt; Apply appropriate non-adherent dressing OR</td>
</tr>
<tr>
<td><strong>Paint wound with antiseptic solution (e.g. povidone iodine, chlorhexidine)</strong></td>
<td>&gt; Manage exudate with: &gt; Alginates, gelling fiber, foam, composite dressing, specialty absorbent</td>
<td>&gt; Paint wound with antiseptic (minimal or light exudate)</td>
</tr>
<tr>
<td><strong>Adhesive dressings</strong></td>
<td>&gt; If dry or wet gangrene: moisture retentive dressing may cause limb threatening infection</td>
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<tr>
<td><strong>Avoid conventional dressing products that require daily dressing changes</strong></td>
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ALGORITHM: MANAGEMENT
Diabetic Foot Ulcer - Refractory

Healable DFU with adequate treatment for 4 weeks but with < 50% decrease in ulcer size

Reassess patient and ulcer
See Algorithm for Assessment of Diabetic Foot Ulcer

Focus on evaluating:
- Differential diagnoses
- Factors mitigating healing
  - comorbidities (e.g., uncontrolled diabetes, malnutrition, immunossuppression)
  - medications (e.g., steroids, immunosuppressants)
  - lifestyle (e.g., smoking)
- Blood supply to the ulcer(s)
- Barriers to adherence to treatment
- Offloading effectiveness
- Presence of infection
- Ulcer moisture balance/ exudate control
- Need for vascular interventions

Then if appropriate consider:
- Biopsy or swab with validated method such as Levine technique to rule out infection/ osteomyelitis.
  - Refer to infectious disease specialist if needed
- Biopsy to rule out malignancy, vasculitis, atypical ulcers
- New TcPO2 study, vascular imaging if no signs of improvement with >6 weeks of treatment
- Consults/referrals:
  - Orthotist, podiatrist, vascular specialist, infectious disease, behavioral medicine, HBO

Elaborate new plan of care
- Consider adjunctive and/or surgical interventions for DFU treatment (a)
- Address any factors or co-morbidities impairing healing
- Reassess interventions for infected or ischemic DFUs. See topics "DFU Associated with Infection - Management" and "DFU Associated with Ischemia - Management"

If DFU is non-healable:
- palliative care
  - Decide between amputation and palliative wound care
  - If decision to amputate: TcPO2 studies to determine amputation level. See topic "Transcutaneous oxymetry"

If considering another differential diagnosis:
- Manage according to likely differential diagnosis

NOTES:
(a) Adjunctive and/or surgical interventions, associated with offloading (when not contraindicated):

- **Biophysical interventions**
  - Hyperbaric oxygen therapy (HBO): indicated for DFU Wagner 3 or higher. See topic "Diabetic Foot Ulcer - Hyperbaric Oxygen Therapy"
  - Negative pressure wound therapy (NPWT): to promote healing of post-surgical wounds in patients with DFU (post amputation and/or skin grafting), or after debridement of non-surgical DFUs
  - Phototherapy: for DFU Wagner 1 or 2

- **Wound coverage**:
  - Autologous skin grafting: blood supply must be adequate, wound bed needs to be comprised of red, healthy granulation tissue.
  - Local or free flaps

- **Cellular and/or tissue based products** (aka skin substitutes): For guidance on how to select CTPs, see "How to Select Cellular and/or Tissue Products"
  - Bilayered engineered skin (e.g. apligraf)
  - Human amnion/chorion membrane allograft (e.g., Affinity)
  - Human neonatal fibroblasts of the foreskin (e.g. Dermagraft)
  - Acellular bilayer matrix, porcine small intestinal submucosal tissue (e.g Oasis) porcine urinary bladder (e.g Matristem)

- **Other biologics**
  - Autologous platelet-rich plasma (e.g. Leucopatch or 3C Patch)
  - Platelet-derived growth factor (e.g, becaplermin)